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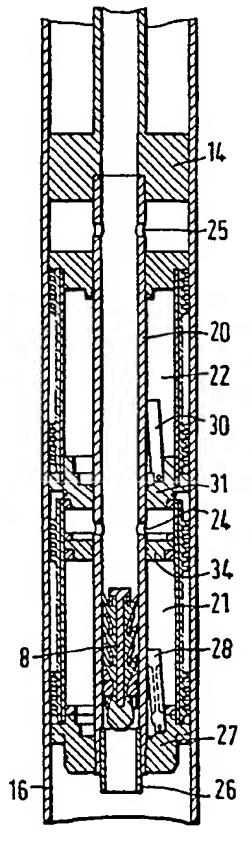
(54) Title: MEANS IN A DOWNHOLE CEMENT PLUG SYSTEM

(57) Abstract

A device for remote release of separation plugs for separating two or more liquid mixtures in connection with, e.g., cementing casings in petroleum, steam or deposition wells, consists of a bottom plug (21), a top plug (22) and possibly several separation plugs which are attached to a pipe-like installation tool (20) equipped with ports (24 and 25) for controlling the flow of liquid to the bottom and top plug respectively, thus allowing the separation plugs to be discharged in turn. In order to be able to cover several alternatives when cementing casings with the use of only one plug set, it has been ensured that the drill pipe plugs (8 and 10) do not land and accompany the separation plugs, but land in and are pulled out together with the installation tool.



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Means in a downhole cement plug system

This invention concerns a device for remote release of plugs for cementing of casings in petroleum and steam wells.

When cementing casings at sea, where the well is drilled by, e.g., floating drilling vessels, the casings are lowered with the drill string and suspended from the well head. In the extension of the installation tool there is usually mounted a set of plugs, which are released during cementing by means of smaller drill string plugs, mounted in a cementing head and which are released before and after the concrete is pumped.

The cementing plugs are normally attached to one another and to the installation tool, either by means of shear screws or locking lugs or a combination of locking devices of this kind. There are also on the market to-day cementing plugs with override release mechanisms. These are also ventilated to prevent them from being released before the drill string plugs land. However, these are often highly complicated and have to be made of strong aluminium alloys, which causes problems during drilling, particularly if the use of a PDC Stratapax drill bit is desired. Present day cementing plugs are not capable of withstanding an incorporated ball seat for the introduction of pressure in order to activate, e.g., hydraulic anchoring mechanisms. Moreover, due to their complexity they are not used for cementing in the traditional manner, where the top of the casing is located at the drill deck. In this type of operation cementing plugs made of plastic material are installed in cementing heads designed for the purpose. These cementing heads represent not only a sizable investment, but also a storage and weight problem, especially on offshore platforms.

The object of the present invention is to cover all conditions during the cementing of casings including extension pipes with one and the same type of plug set, thereby achieving a substantial rationalization in all areas.

This object is achieved according to the invention, the extension of the installation tool and the use of this in combination with the cement plugs being designed according to the characteristic features indicated in the following patent claims.

An embodiment of the invention is explained in more detail in the following section with reference to accompanying drawings, in which:

Fig. 1 is a schematic illustration of the cementing plugs mounted on the extension of the installation tool which contains the casing on the drill string with the drill pipe plugs mounted in the cementing head.

Fig. 2 is a side view/axial section of the cementing plugs mounted on the extension of the installation tool where the first drill string plug has landed in it.

Fig. 3 is a side view/axial section of the bottom plug on the way downwards in the casing with the valve closed and with cement behind, while at the same time drill string plug no. 2 has landed in the extension of the running tool.

Fig. 4 is a side view/axial section illustrating that the bottom plug has landed in the seat at the bottom of the casing, while the top plug has been released and is on the way downwards with cement in front and drilling mud behind.

Fig. 5 is an alternative version where the sealing function of the flap valves 28 and 30 in fig. 2 is replaced by the stoppers 43 and 42 respectively. On the separation plugs 21 and 22 the flap valves are replaced by, e.g., a groove and a snap ring 45 and 47. The stoppers are equipped with a corresponding groove 48 and 44 with which the snap rings engage when the respective separation plugs pass. The snap ring on the drill pipe plug 21 is arranged in such a manner that it does not engage with stopper 42 when this is passed, thus preventing the first plug 21 from taking both the stoppers with it when it passes. The stopper 42 is attached with a tear-off mechanism 40 to the lower part 26 of the installation tool. The stopper 43 is attached with a tear-off mechanism 41 to the stopper 42. Before discharge, liquids can pass the installation tool and the plugs through the opening at 46.

In fig. 1 the downhole cementing plug system is illustrated schematically. The well 1 extends downwards from the seabed 2 with water 3 over it. Above the surface 4 the drill deck 5 is shown with the cementing head 6 with inlet manifold 7 for drilling mud and concrete. In the cementing head 6 is mounted the first drill string plug 8, which is kept in place by release mechanism 9, while the second drill string plug 10 is kept in place by release mechanism 11. The

cementing head 6 is also equipped with a ball release mechanism 12 for the activation of, e.g., hydraulic anchoring mechanisms.

The drill string 13 connects the cementing head 6 to the installation tool 14, which is mounted on the suspension mechanism 15 for the casing 16. The suspension mechanism 15 lands in the suspension mechanism 18 of outer casing 17. The outer casing 17 has previously been cemented to the well 1 with concrete 19.

The installation tool 14 has a pipe extension 20, to which the bottom plug 21 and the top plug 22 are mounted. Reference number 23 is a so-called cement shoe with non-return valve 24. The equipment as shown will be used for cementing casings including extension pipes.

Fig. 2 shows that the pipe extension 20 has two external threaded sections for mounting of the bottom plug 21 and the top plug 22 respectively. The pipe extension 20 is equipped with perforations 24 and 25. Moreover, a receiver 26 for the drill strings plugs has been mounted on the pipe extension 20, and possibly also a ball seat which will be shear-pinned over the uppermost perforations.

Before cementing, a separation liquid is first pumped between the drilling mud and following concrete. After an estimated volume of separation liquid has been pumped in, the release mechanism 9 is rotated 90 and drill string plug 8 is pumped downwards in the drill string 13 followed by concrete. On the way down the drill string plug 8 cleans the drill string 13 of drilling mud and other impurities. When it lands on the receiver 26, the internal pressure over the drill string plug 8 will rise. This increase in pressure results in a downward-acting force being exerted on the bottom plug 21, while the pressure over the top plug 22 will be balanced. When a certain pressure/downward-acting force has been achieved, the threaded connection to the nose section 27, which holds the bottom plug 21 in contact with the pipe extension 20, will be torn off. The bottom plug 21 is now released from the pipe extension 20 and is forced downwards in the casing 16. Since the bottom plug 21 leaves the pipe extension 20 there is no longer anything holding the flap valve 28 in an open position and this closes the hole in the nose section 27 with the aid of a built-in spring (not shown).

When the desired amount of concrete has been introduced into the drill string, the drill string plug 10 is released and is pumped down through the drill string with drilling mud behind it, until it lands on the drill string plug 8. The perforations 24 are now sealed and the internal pressure in the drill string over the drill string plug 10 will rise. This rise in pressure results in a downward-acting force which affects the top plug 22. When a certain pressure/downward-acting force is achieved, the thread connection to the rear section 29, which keeps the top plug 22 in contact with the pipe connection 20, will be detached. The top plug 22 is now released from the pipe extension 20 and forced downwards in the casing 16. Since the top plug 22 leaves the pipe extension 20 there is no longer anything holding the flap valve 30 in an open position and it closes the hole in the nose section 31 with the aid of a built-in spring (not shown).

When the bottom plug 21 lands in the cement shoe 23 the rupture disc 32 in the flap valve 28 will burst and the concrete can be pumped through.

When the top plug 22 lands on the bottom plug 21, the nose section will be detached from the plug casing 33 when the pressure is increased. The nose section 31 will further act as a piston and force the rear section 34 loose before finally landing on top of the nose section 27.

Here we have a solid construction which can withstand high pressure (bumping), thus allowing the casing's integrity to be checked in wet concrete. Since the plugs can only be produced in plastic materials, it will not take long to drill out both top and bottom plugs with reciprocal rotary lugs. Both the drill pipe plugs are returned to the surface when the installation tool 14 with the pipe extension 20 is pulled up.

PATENT CLAIMS

1. A device for remote release of separation plugs for separating two or more liquid mixtures in connection with, e.g., cementing of casings in petroleum, steam or deposition wells, comprising a bottom plug (21), a top plug (22) and possibly several separation plugs which are attached to a pipe-like installation tool (20) equipped with ports (24 and 25) for controlling the flow of liquid to the bottom and top plug respectively, thus enabling the separation plugs to be discharged in turn,
characterized in that the drill pipe plugs (8 and 10) do not land and accompany the separation plugs, but land in and are pulled out together with the installation tool.

2. A device for remote release of plugs for cementing casings in petroleum and steam wells, comprising a bottom plug (21), a top plug (22) and possibly several cement plugs mounted on a perforated pipe extension (20),
characterized in that on the perforated pipe connection (20) with a seat for receiving drill pipe plugs (8 and 10) and possibly a ball seat, cementing plugs (21 and 22) are mounted individually, either by means of shear screws, locking hooks or threaded connection, which can be detached, and that the cementing plugs are equipped with a sealing device in the form of a flap valve or the like.

3. A device according to claim 1 or 2,
characterized in that the separation plugs are equipped with a valve which is kept open by the installation tool and that the drill pipe plugs control the flow of liquid behind the lower and upper plug respectively and provide an overpressure which produces a force which triggers a temporary locking mechanism and forces the plugs downwards in the casing until the first part of the plugs has left the installation tool and the valve mounted on the plug closes by means of, e.g., a spring device and takes over the sealing function of the pipe's internal cross section which was performed during the discharge phase by the installation tool together with the drill pipe plug which landed in the installation tool, and which ensures that the plug will be transported downwards in the pipe.

4. A device according to claim 1 or 2,
characterized in that the top plug's nose section (31) is cut from the plug casing and acts as a piston which takes with it the bottom plug's rear section (34), lands on the bottom plug's nose section (27) and forms a compact sealing plug,

equipped with an anti-rotation device for rapid drilling, which can withstand high pressure.

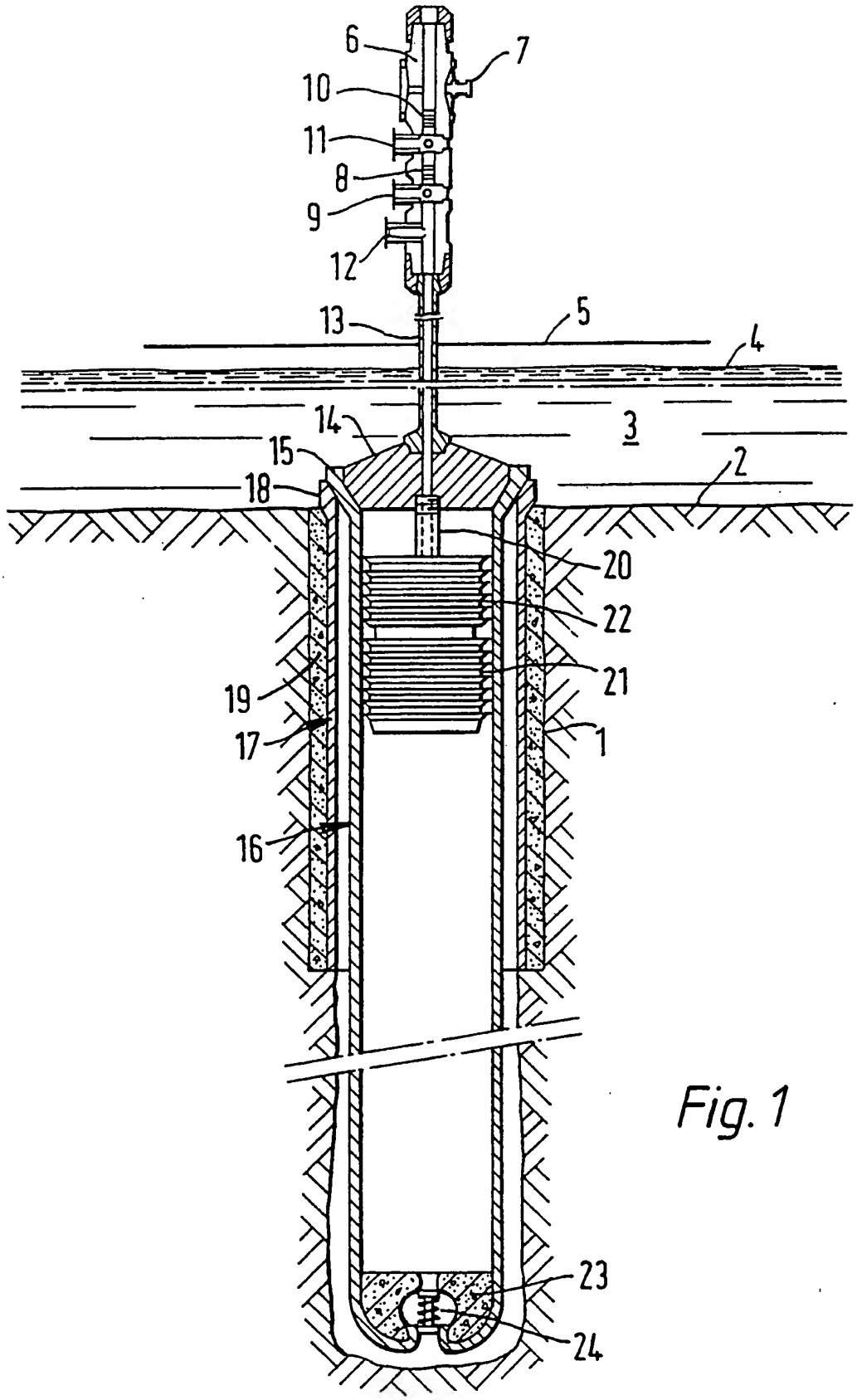

Fig. 1

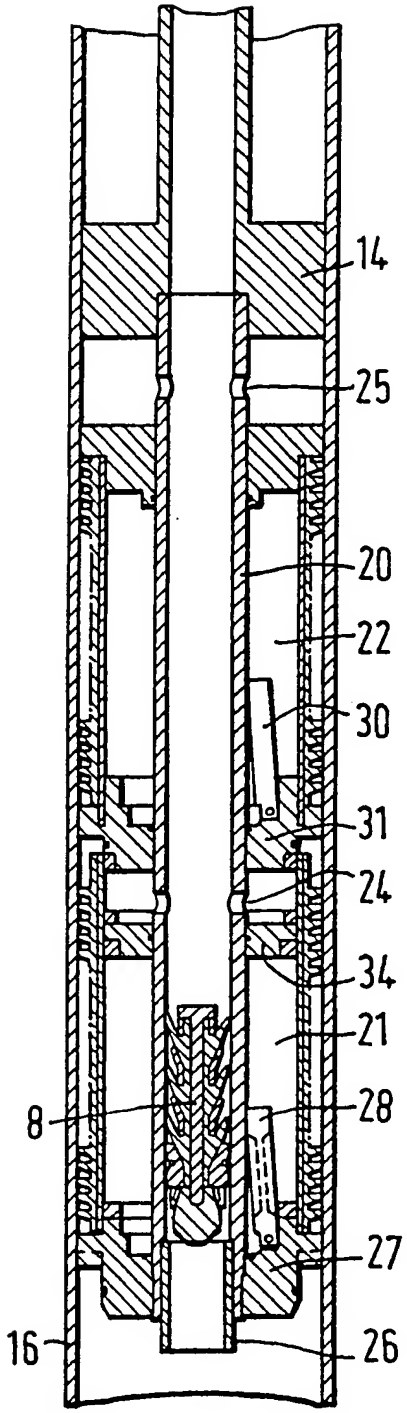
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Fig. 2

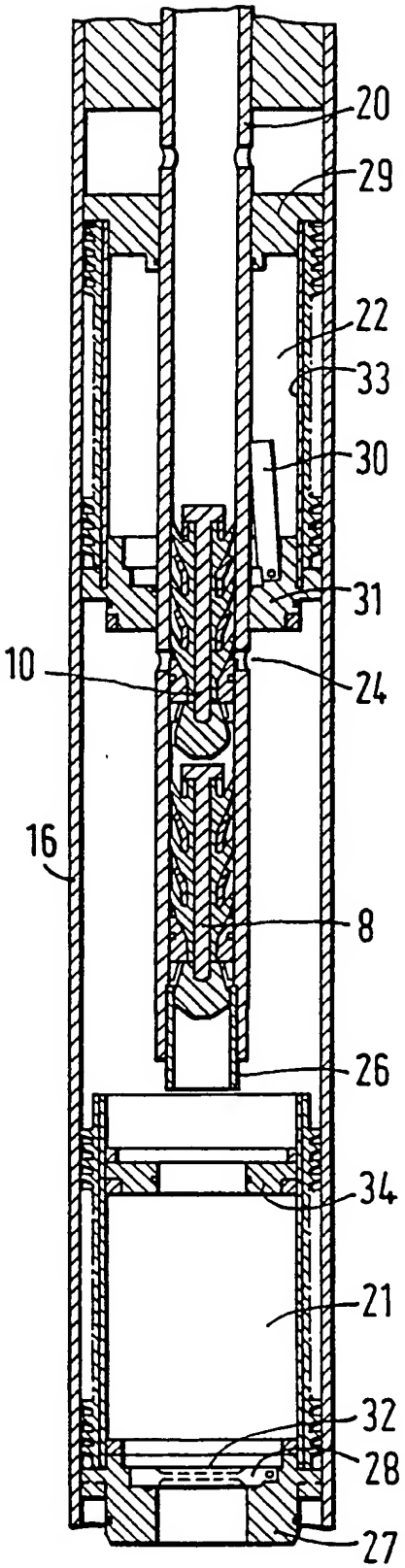
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Fig. 3

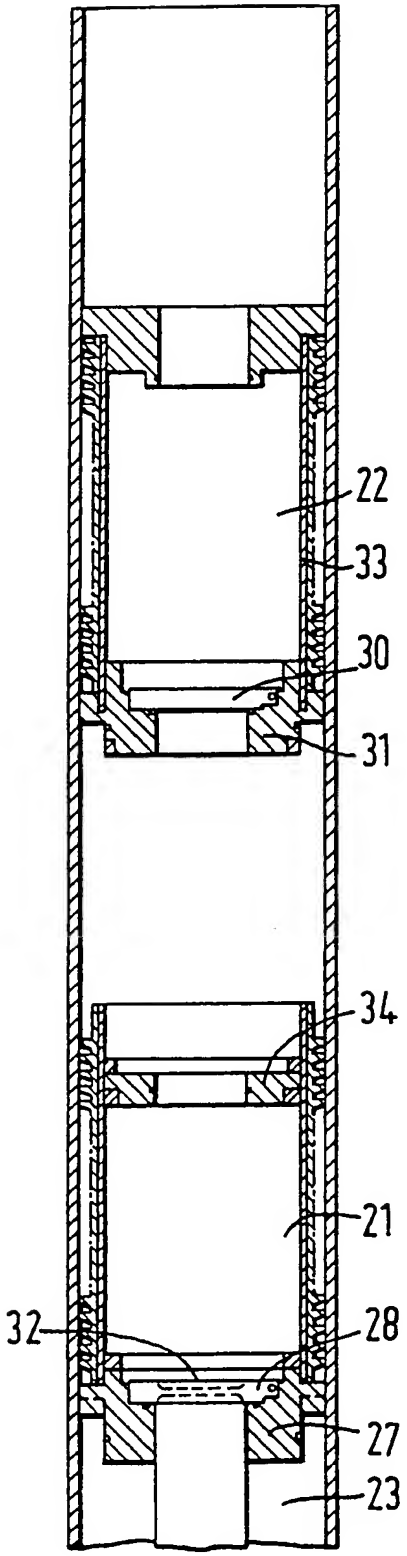
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Fig. 4

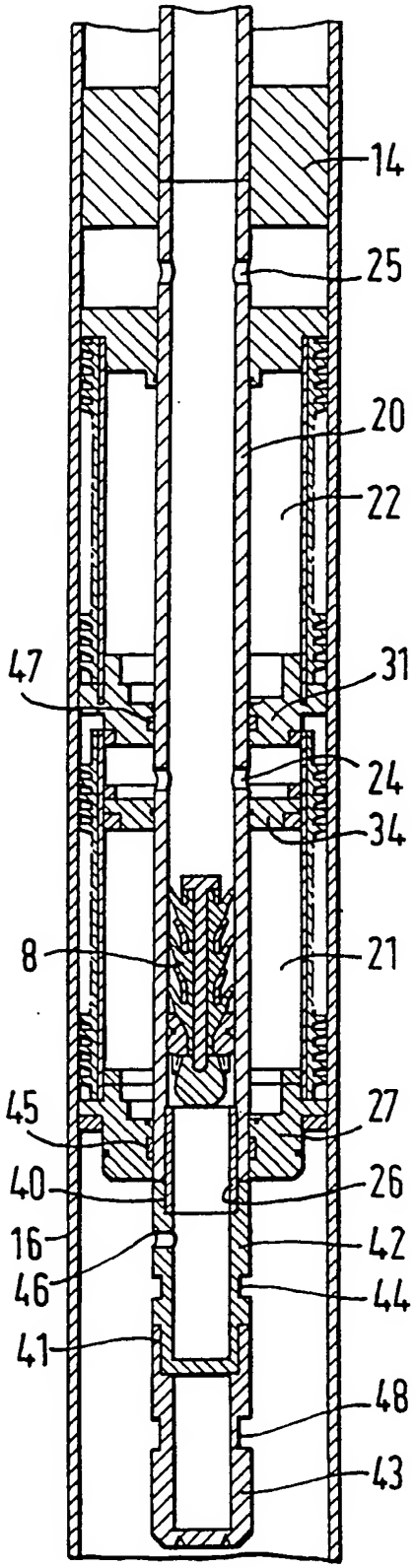
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Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 94/00086

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: E21B 33/16
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	NO, B, 130328 (BYRON JACKSON, INC.), 12 August 1974 (12.08.74), the wholed document --	1-4
A	US, A, 4809776 (B.J. BRADLEY), 7 March 1989 (07.03.89), the whole document --	1-4
A	EP, A2, 0167285 (HALLIBURTON COMPANY), 8 January 1986 (08.01.86), the whole document --	1-4

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR, A1, 2663678 (COMPAGNIE DES SERVICES DOWELL SCHLUMBERGER), 27 December 1991 (27.12.91), page 7 - page 11, figures -- --------	1-4

INTERNATIONAL SEARCH REPORT

Information on patent family members

02/07/94

International application No.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
NO-B- 130328	12/08/74	NONE	
US-A- 4809776	07/03/89	AU-A- 2178788	09/03/89
		CA-A- 1304678	07/07/92
		DE-A- 3866637	16/01/92
		EP-A,B- 0306306	08/03/89
EP-A2- 0167285	08/01/86	AU-B- 577120	15/09/88
		AU-A- 4283685	12/12/85
		CA-A- 1236771	17/05/88
		US-A- 4624312	25/11/86
FR-A1- 2663678	27/12/91	NONE	